Green Building Materials

Determining the True Definition of Green

Cody Fithian and Andrea Sheets

THE UNIVERSITY OF TEXAS AT AUSTIN
SCHOOL OF ARCHITECTURE

csd
Center for Sustainable Development

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Cody Fithian
Andrea Sheets

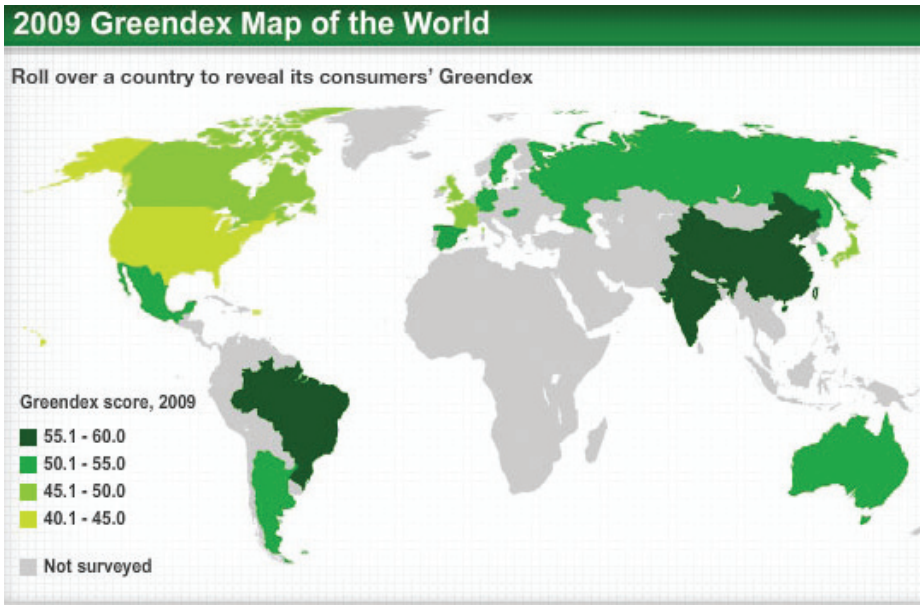

Fig. 01 Survey conducted by National Geographic and international polling firm Globescan to 17,000 consumers on a variety of issues measuring their eco-friendliness.

What does "green" really mean?

"Going Green" seems to be the new and popular thing to do. It is an easy statement to make, but gives very little detail of how one will address such a global issue.

There are currently over fifty regional and national green labeling programs throughout the United States. Each of these have similar yet quite different versions of rating systems and qualifying characteristics that they look for in a green building. Some focus on only the end results and completely overlook what happens during the gathering and manufacturing of materials. Others look more heavily at issues of economics and energy savings while deeming other issues like the distance a material travels or the toxins it could emit into the air as much less important.

As long as a material has at least one positive impact on the environment, it could be defined as green. However when analyzed more carefully, this same material could actually be harming the environment more than it is helping. Therefore it is extremely important to know who is labeling a material as green. Many labeling organizations are sponsored by material industries and will consequently be lenient in granting those materials green status. This complicates the process of determining exactly how green specific materials are.

The trouble in identifying the truest definition of green may be that there is no absolute definition. The lack of public unity in a definition has caused the meaning to become convoluted and impossible to distinctly pronounce. However, by examining the problems and corruption of the green labeling industry, one can indeed gain an understanding of the complexity of variables that contribute to the greenness of a material and how to

apply these principles in design and building.

Green Labeling Programs

There are over fifty green labeling programs across the country.[1] This is an overly abundant number of organizations who are all in theory supporting and dealing with the same things.

Some common issues that they all take into consideration are:

- Construction techniques
- Waste reduction/recycling through construction phase
- The indoor environment and its use of environmental products
- Water-efficient processes
- Renewable energy options
- Smart growth and sustainable land development practices

Fig. 02 Some of the many Green Labeling Program logos.

However all of the programs weigh the importance of these issues differently and consequently establish their own unique checklists. The decision of which matters are more important to a specific label often stems from the desires of sponsors and investors. If a labeling program receives funding from another organization, they will unfairly rate that organization's products as greener than the really are.

Corruption in the green labeling industry makes it difficult to discern which are the most credible and trustworthy programs. Knowing who is behind the labeling is the first step in uncovering truly green materials.

Although there are many green labeling programs in America, there are really only a handful that are well-known. Builders are more likely to choose materials with these ratings. This is because they want their efforts to be widely recognized, and they automatically trust these companies since everyone else seems to think they are superior.

Four of the largest and most recognized green labeling programs are:

- LEED
- Energy Star
- Green Globe
- Green Seal

Each are administered by different organizations, have their own rating criteria and focus most heavily on different issues. By looking at all four of these, one can begin to see overlaps and shortcomings. One can begin to develop a more holistic approach to defining a true green material.






LEED

Definition
- an internationally recognized green building certification system
- provides third-party verification that a community or building was designed and built using strategies aimed at improving performances in energy savings, water efficiency, CO2 emissions/ reductions, improved indoor environmental quality, and stewardship of resources and sensitivity to their impact

Developed by the U.S. Green Building Council, LEED provides a framework for implementing measurable green building design, construction, operations, and maintenance solutions. It works throughout the building lifecycle. Certification is achieved through the third-party independent Green Building Certification Institute.

Rating System and Criteria

Sustainable Sites
- discourages development on previously undeveloped land
- minimizes a building's impact on ecosystems and waterways
- encourages regionally appropriate landscaping
- controls stormwater runoff
- rewards smart transportation choices
- reduces erosion, light pollution, heat island effect and construction-related pollution

Water Efficiency
- goal is to encourage smarter use of water inside and out
- water reduction, which is typically achieved through more efficient appliances, fixtures and fittings inside and water-wise landscaping outside

Energy and Atmosphere
- commissioning
- energy use monitoring
- efficient design and construction
- efficient appliances, systems, and lighting
- use of renewable and clean sources of energy, generated on-site or off-site

Materials and Resources
- encourages the selection of sustainably grown, harvested, produced, and transported products and materials
- promotes reduction of waste as well as reuse and recycling
- takes into account reduction of waste at a product's source

Indoor Environment Quality
- promotes strategies that can improve indoor air as well as providing access to daylight and views and improving acoustics

Locations and Linkages
- encourages homes being built away from environmentally sensitive areas
- instead, being built in infill, previously developed, and other sites
- rewards homes built near already-existing infrastructure, community resources and transit
- encourages access to open space for walking and physical activity and time spent outdoors

Awareness and Education
- encourages homeowners and real estate professionals to provide homeowners, tenants, and building managers with education tools they need to understand what makes their home green

Innovation in Design
- provides bonus points for projects that use new and innovative technologies and strategies to improve a building's performance beyond what is required by LEED credits or green building considerations that are not specifically elsewhere in LEED
- rewards projects using a LEED Accredited Professional to ensure a holistic, integrated approach to the design and construction phase

Regional Priority
- USGBC's regional councils, chapters and affiliates have identified the environmental concerns that are locally most important for every region of the country, and six LEED credits that address those local priorities were selected for each region
- a project that earns a regional priority credit will earn one bonus point in addition to any points awarded for that credit

LEED Rating Systems
- New Construction
- Existing Buildings: Operations + Maintenance
- Commercial Interiors
- Core and Shell
- Schools
- Retail
- Healthcare
- Homes
- Neighborhood Development

Figure 03

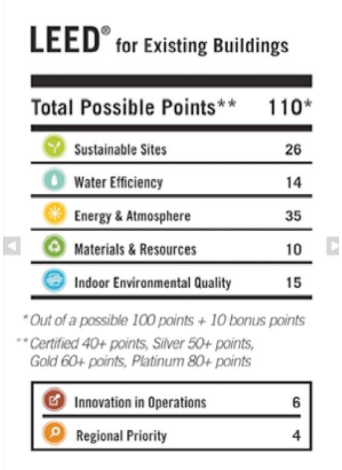

Figure 04

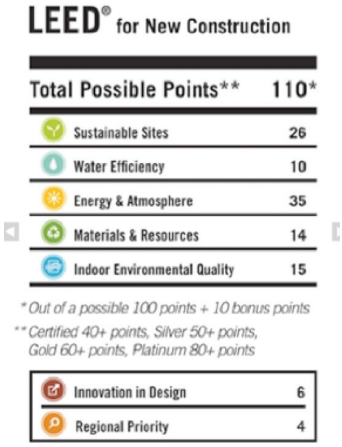

Figure 06

Figure 05

Buildings account for 71% of America's electricity use and 38% of all greenhouse gas emissions, according to the Department of Energy. LEED claims to cut those numbers by 25-30%.

While this is an improvement, how does it compare to the 50% target adopted by architecture firms that have signed on to the Architecture 2030 initiative.

Furthermore, the limitations of LEED emanate from its design. The bike rack earns you the same amount of points as buying 50% of your energy from a renewable source, or that there are no regional adjustments; saving water in Seattle earns the same point as in Tucson. Until recently, you could certify a building with no energy measures.

The current standard is to beat theASHRAE/IESNA baseline by 14%. Shouldn't all 10 points in the LEED energy category be required? Which would mean beating the ASHRAE standard by 42%, which isn't enough to start solving the climate crisis. Developers are tempted to pick and choose sustainable solutions in order to earn points.[2]

Energy Star

Definition

- A government backed organization focusing on improving energy efficiency
- Administered by the US Environmental Protection Agency and the US Department of Energy
- Standards for Energy Star rated buildings are set by the EPA

Their motto is “Energy-efficiency comes first”. Founded in 1992, Energy Star began as a labeling program that only rated consumer products. Products like household appliances and air conditioning units with the Energy Star label now save between twenty and thirty percent of energy.

Buildings can receive an Energy Star Label too. To qualify they must reduce the amount of energy needed to operate and cause less carbon dioxide emissions than other buildings of the same type.

Rating System and Criteria

- Buildings rated on a 1-100 scale in comparison to other buildings of the same type
- A score of 75 or above can earn an Energy Star label

To be rated, you submit data about your building. This information includes total square footage, number of occupants, number of computers, location, etc. A computer than takes this data and formulates a figure that would be the optimal energy spending. This is derived from data gathered by the Department of Energy’s Energy Information Administration. Then your building is evaluated in comparison to this data and ranked among its peers. The top twenty five percent in each building type category receive the Energy Star label.

Currently Energy Star has ratings for the following building types:

- Bank/financial institutions, courthouses, hospitals (acute care and children’s), hotels and motels, K-12 schools, medical offices, offices, residence halls/dormitories, retail stores, supermarkets, and warehouses (refrigerated and non-refrigerated)
- Industrial Facilities: automobile assembly plants, cement plants, and corn refineries
- Municipal Water Treatment Plants

To determine if a building qualifies to be Energy Star rated, fifty percent of the gross square footage (excluding garages/parking) must belong to one of the above categories.[3]

Problems with Energy Star

Although Energy Star takes a strict approach to cutting down on energy use therefore reducing greenhouse gas emissions and saving money, it fails to look at materials in depth. They are really only focused on the way that the end product performs in relation to energy savings. Whatever means needed to be taken to get a product a certain way, even if extremely harmful to the environment, would be dismissed by Energy Star. Plus there have been reports that the organization sometimes uses loose and outdated standards and lets companies rate their own products.[4]

Fig. 07 Energy Star Logo

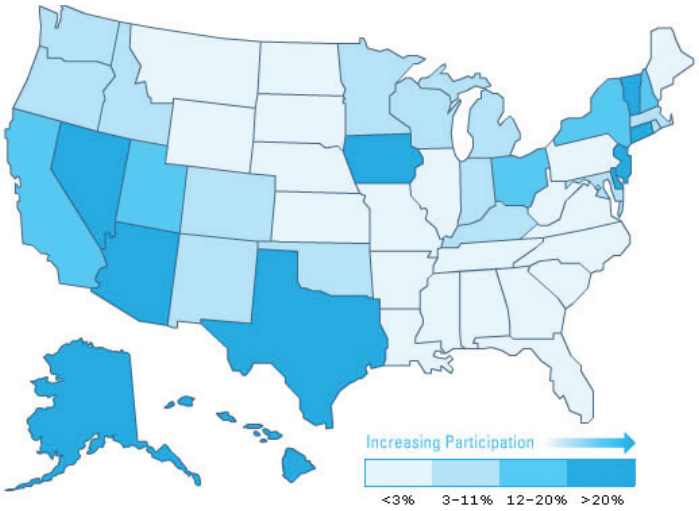

Fig. 08 Statewide participation rates in the Energy Star program.

Green Globe

Definition
- A guidance and assessment program that offers realistic and achievable ways to increase the sustainability of commercial buildings
- Administered by the Green Building Initiative in the U.S.

The most important components of the Green Globe program are:
- Comprehensive environmental assessment protocol
- Software tools that speed and ease online assessment
- Best practices guidance for green construction and operations
- Experienced green building assessors

Green Seal uses the International Organization for Standardization (ISO) standards for environmental labeling programs, ISO 14020 and 14024.

Rating System and Criteria
- 1000 point scale in multiple categories: energy, indoor environment, site, water, resources, emissions, project/ environmental management
- Can earn 1-4 globes for achieving at least 350 points

After a building has earned at least 350 points, third party independent assessors review building documentation and walk through the site. The site walk through is very intensive and includes a review of all construction documentation as well as the physical walk-through.

Buildings that earn green globes should:
- use less energy
- conserve natural resources
- emit fewer pollutants

Green Globe does look at the total life cycle assessment of the materials in the building. This is different from many other labeling programs that do not look into the source of the materials and products. They also separate buildings into “new construction” and “continual improvement of existing buildings”.[5]

Fig. 09 Green Globe logo

Green Globes™ Ratings		
85-100%		Reserved for select buildings that serve as national or world leaders in reducing environmental impacts and efficiency of buildings.
70-84%		Demonstrates leadership in energy and environmentally efficient buildings and a commitment to continual improvement.
55-69%		Demonstrates excellent progress in reducing environmental impacts by applying best practices in energy and environmental efficiency.
35-54%		Demonstrates movement beyond awareness and a commitment to good energy and environmental efficiency practices.

Fig. 10 Green Globe’s Rating System.

Green Seal

Definition

- a non-profit, third party certifier and standards development party
- the largest U.S.-based ecolabelling organization
- the U.S. member of GEN (Global Ecolabelling Network), which consists of 26 of the world's leading ecolabelling programs
- develops standards from green cleaning products to lodging

Green Seal uses life cycle assessment, evaluating products from raw materials extraction to manufacturing and use to disposal or recycling. If a product meets Green Seal standards, it will be awarded the Green Seal. This organization works with the marketplace in an effort to create a "more sustainable world".[6]

Fig. 11 Green Seal Logo.

Green Seal Environmental Standards

- Construction Materials, Equipment and Systems
- Facility Operations, Maintenance and Services
- Hospitality, Lodging and Food Service
- Home Products and Services
- Office Products and Communications
- Personal Care and Consumer Packaged Goods

Conditionally Green Materials

The majority of available green products have one or more of the following health and/or environmental attributes:

- Promote good indoor air quality (typically through reduced emissions of VOCs)
- Durable and require little maintenance
- Incorporate recycled content (post-consumer and/or post-industrial)
- Have been recycled from existing or demolished buildings
- Are made using renewable resources
- Have low embodied energy
- Do not contain Chlorofluorocarbons, Hydrochloroflurocarbons or other ozone depleting substances
- Obtained from local resources and manufacturers
- For wood or bio-based products, they employ sustainable harvesting practices
- Recyclable
- Biodegradable

However not many, maybe even none at all, carry all of these characteristics. Even some materials that are claimed to be the "greenest" are missing at least one of these attributes. Here are just a few of such cases:

Bamboo

Usually used as flooring, this is the material that all architects seem to turn to for a quick addition of sustainability to their designs. However, bamboo is not always the greenest choice. Although it is a rapidly renewable product, the forest that it comes from is sometimes not. In order to ensure this materials green credibility, it needs to come from a FSC source.[7]

In general, a better and greener flooring material would be rammed earth. It is just as strong and durable as concrete and its source can be at the immediate site. It has ninety percent less embodied energy than concrete also.[8]

Insulated Concrete Forms (ICF)

These are stackable blocks of expandable polystyrene which are filled with concrete and re-bar as needed. They are strong and extremely well insulated cutting down on energy costs greatly. They also get rid of the necessary wood formwork traditionally used in poured concrete forms. However, the polystyrene is a fossil fuel based product and could contain VOCs. These are extremely harmful to a person's health. There is an ICF made from recycled wood chips called "Durisol", and this would be the best choice for an ICF wall.[9]

Low VOC Paint

The name says it all. Low VOC is better for the environment and everyone's health. However this label is misleading. In order to be considered "Low VOC", the paint must contain less than 250 grams per liter of the compound. However many companies count the grams per liter before the pigment is added, which has a large amount of VOC in it as well. So these really aren't what they claim to be. The best option for paint is a Zero VOC paint.[10]

Recycled Denim Insulation

This material is 100% recycled. So what couldn't be green about that? First, the insulation value is extremely poor (about equal to that of fiberglass). Second, it causes vapor barrier issues. Third, mice love to live inside of it. Finally, in most cases the blue jeans used for the insulation are shipped all over the country, wasting fuel and negating the "greeness" of the product.[11]

Structurally Insulated Panels (SIPS)

These are wall panels comprised of rigid foam insulation sandwiched between two pieces of oriented strand board. They can have insulative values up to R-60. This high value saves energy and money. However, they are usually not made of green materials. Some companies are now using bio-based materials, but others still used expanded polystyrene, which as in ICF can contain VOCs and be a health and environmental hazard.[12]

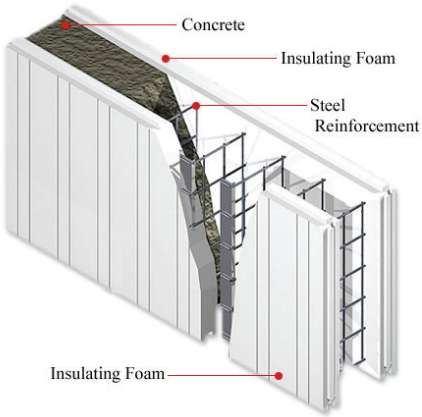

Fig. 12 Insulated Concrete Forms.

Fig. 13 Recycled Denim Insulation.

Fig. 14 Structurally Insulated Panels.

Conclusion

Green building materials encompass a vast area of topics and materials. The application and use of these materials further complicates the subject.

When researching and learning about all things green, there are some things to be aware of and watch out for. First, always check the sponsors for the respective certifying organization. You need to be aware of organizations motives because they are not always as transparent as bringing the best green materials to the national stage. Some are more sinister. Asking the question, "Who is profiting?" can give a strong indicator of a product or practice's true level of green value. Green building materials not only need to benefit the environment, but with the best possible effort manufacturers can put forward. Settling for less undermines the green effort.

Do not look only at the end product. You must consider the energy used to manufacture products, the waste generated, and most important, how the product is used over its lifetime. Perhaps additional consumption is required to maintain the use of a product. Also, what happens to the product at the end of its lifetime and how is this method is undertaken? Is the product simply disposed of or is there potential to re-use and repurpose the material components of the product?

The bottom-line is that everything is conditional, depending on what frame a product or practice is being analyzed through. Be wary of websites that claim to be independent but have advertisements, especially when you are hunting for sustainable materials and solutions in your area.

Green Products Databases

- Eco-structure Magazine: editorials cover green building from all angles, providing information about rating systems and diverse green building techniques: http://www.eco-structure.com/
- Environmental Design + Construction Magazine: source for integrated high-performance buildings: http://www.edcmag.com/
- EPA Comprehensive Procurement Guidlines: promotes the use of recycled materials in the manufacture of new products: http://www.epa.gov/epawaste/conserve/tools/cpg/index.htm
- EPA Environmentally Preferable Purchasing Program's Database of Environmental Information for Products and Services: http://yosemite1.epa.gov/oppt/eppstand2.nsf
- GSA Federal Supply Service "Environmental Products and Services Guide" (2003-2004): http://www.gsa.gov/gsa/cm_attachments/GSA_DOCUMENT/2003_4_epsg_optB(final%20web%20version2)_R2OP1-z_0Z5RDZ-i34K-pR.pdf
- Guide to Resource Efficient Building Elements: http://www.crbt.org/hc3.asp
- A Sourcebook for Green and Sustainable Building: a collection of information and sources of materials, assistance and resources in sustainable solutions: http://sustainablesources.com
- Green Building Initiative: a non-profit organization and the U.S. licensor of Green Globes: http://www.thegbi.org
- Sustainable Buildings Industry Council: a non-profit organization that puts together the "Whole Building Design Guide" or comprehensive applications of sustainable principles: http://www.sbicouncil.org/
- Green2Green: compares building materials' environmental performances: http://www.green2green.org
- Always check locally first!

Glossary of Green Terms

When reading about green materials, certain terms appear quite frequently. This is a greatly summarized list of some of those terms.[13]

Carbon Footprint: A measure of an individual's impact on the environment in terms of the amounts of greenhouse gases produced, measured in units of carbon dioxide.

Carbon Sink: A natural or man-made reservoir that accumulates and stores some carbon-containing chemical compound for an indefinite period. Major examples are oceans, forests and landfills.

Chlorofluorocarbon: CFC; an organic compound that contains carbon, chlorine and fluorine. Most widely found in refrigerants and aerosols, when released into the air these compounds lead to ozone depletion.

Embodied Energy: The available energy that was used in the work of making a product. This is an accounting methodology which aims to find the sum total of the energy necessary for an entire life cycle process.

Forest Stewardship Council: FSC; A non-profit organization which promotes responsible management of the world's forests. It sets standards and independently certifies and labels forest products

Green Products: Products that have been certified through a process of "eco" or "green" labeling, which insures that the product was handled, made or grown under conditions that meet standards of sustained use, pesticide application and harvesting as well as certain social and economic criteria for workers.

Greenwashing: The practice of companies disingenuously spinning their products and policies as environmentally friendly.

Greenway: Undeveloped linear open space usually set in cities, set aside and used for recreation or conservation. Greenways can be used to created connected networks of open space that include traditional parks and natural areas.

Half-life: The time required for a pollutant to lose half of its effect on the environment.

Post-Consumer Recycled Material: reclaimed waste product that has already served a purpose to a consumer, and has been diverted or separated from waste management collection systems for recycling. Example: used newspaper that is made into cellulose building insulation.

Pre-Consumer Recycled Material: A material that is removed from production processes (including scrap, breakage, or by-products) and reused in an alternative process before consumer distribution. Example: mineral (slag) wool, a by-product of the steel blast furnace process, used for mineral fiber acoustical ceiling panels.

Rapidly renewable products: any material that regenerates in ten years or less: i.e. Bamboo, cork, wool and straw.

Sustainable Harvesting: Harvesting only what the ecosystem and region naturally produce and no more. This provides future generations with the assurance of these resources.

Volatile Organic Compound: V.O.C. An organic chemical compounds that have high enough vapor pressures to vaporize and enter the atmosphere. They can come from methane, formaldehyde, office equipment

Recyclable vs Green vs Sustainable Materials

Recyclable: A material that can be used again.

Green: A material that has at least one positive environmental characteristic.

Sustainable: A material that meets the needs of the present without compromising those of future generations.

Notes

1. Big Room, Inc., “Who’s Deciding What’s Green?”, Ecolabelling.org, www.ecolabelling.org, accessed October 2009.

2. U.S. Green Building Council. LEED. U.S. Green Building Council. http://www.usgbc.org/DisplayPage.aspx?CategoryID=19. Accessed October 2009.

3. U.S. Environmental Protection Agency and U.S. Department of Energy, “Energy Star”, U.S. Environmental Protection Agency, http://www.energystar.gov, accessed October 2009.

4. American Council for an Energy-Efficient Economy and Consumer Reports, http://www.applianceadvisor.com, accessed October 2009.

5. Green Globe International, Inc., “Green Globe”, www.greenglobe.org, accessed October 2009.

6.Green Seal and Environmental Media Association, “Green Seal: The Mark of Environental Responsibility”, Green Seal, http://www.greenseal.org, accessed October 2009.

7.-12. Discovery Communications, “Green Materials Guide”, Planet Green, http://www.planetgreen.discovery.com, accessed October 2009.

13. Richard E. Saunier and Richard A. Meganck, *Dictionary and Introduction to Global Environmental Governance* (London: TJ International Ltd., 2009).

Figures

Figure 01: National Geographic and GlobeScan, “Greendex: Survey of Sustainable Consumption”, National Geographic, http://www.nationalgeographic.com/greendex/#, accessed October 2009.

Figure 02: Big Room, Inc., “Who’s Deciding What’s Green?”, Ecolabelling.org, www.ecolabelling.org, accessed October 2009.

Figure 03: U.S. Green Building Council, “LEED”, www.usgbc.org/LEED, accessed October 2009.

Figure 04: U.S. Green Building Council, “LEED”, www.usgbc.org/LEED, accessed October 2009.

Figure 05: U.S. Green Building Council, “LEED”, www.usgbc.org/LEED, accessed October 2009.

Figure 06: U.S. Green Building Council, “LEED”, www.usgbc.org/LEED, accessed October 2009.

Figure 07: Energy Star, “Energy Star”, U.S. Environmental Protection Agency, http://www.energystar.gov/, accessed October 2009.

Figure 08: Discovery, “Tree Hugger”, www.treehugger.com, accessed October 2009.

Figure 09: Green Globe Internation, Inc., “Green Globe”, www.greenglobe.org, accessed October 2009.

Figure 10: Green Globe International, Inc., “Green Globe”, www.greenglobe.org, accessed October 2009.

Figure 11: Environmental Media Association Green Seal Program, “Green Seal”, www.greenseal.org, accessed October 2009.

Figure 12: Insulation Concrete FormworkAssociation, “What is ICF?”, United Kingdom, www.icfinfo.org.uk, accessed October 2009.

Figure 13: Instructables, “Make, How To, and DIY”, www.instructables.com, accessed October 2009.

Figure 14: Sustainable Design Update Blog, “10 Tips for Building a Sustainable Home”, www.sustainabledesignupdate.com, accessed October 2009.

References

Reference 01 U.S. Environmental Protection Agency and Green Power Partnership. Glossary. U.S. Environmental Protection Ageny. http://www.epa.gov/greenpower/pubs/glossary.htm. Accessed October 2009.

Reference 02 Saunier, Richard E., and Richard A. Meganck. 2009. *Dictionary and Introduction to Global Environmental Governance.* London: TJ International Ltd.

Reference 03 Hands-on-Guide and Building Intelligence Group. Green Building Dictionary. Hands-on-Guide. http://www.green-building-dictionary.com. Accessed October 2009.

Reference 04 U.S. Environmental Protection Agency and U.S. Department of Energy. Energy Star. U.S. Environmental Protection Agency. http://www.energystar.gov. Accessed October 2009.

Reference 05 National Institute of Building Sciences. Sustainable. Whole Building Design Guide. http://www.wbdg.org/design/sustainable.php. Accessed October 2009.

Reference 06 Discovery Communications. Green Materials Guide. Planet Green. http://www.planetgreen.discovery.com. Accessed October 2009.

Reference 07 U.S. Green Building Council. LEED. U.S. Green Building Council. http://www.usgbc.org/DisplayPage.aspx?CategoryID=19. Accessed October 2009.

Reference 08 Kamenetz, Anya. 2007. The Green Standard? *Fast Company,* Issue 119 (October), http://www.fastcompany.com/magazine/119/the-green-standard.html. Accessed October 2009.

Reference 09 Green Seal and Environmental Media Association. Green Seal: The Mark of Environental Responsibility. Green Seal. http://www.greenseal.org. Accessed October 2009.

Reference 10 Big Room, Inc. Who’s Deciding What’s Green? Ecolabelling.org. www.ecolabelling.org. Accessed October 2009.

Reference 11 Green Globe International, Inc. Green Globe. www.greenglobe.org. Accessed October 2009.